Comparison of Chromospheric and Coronal Chirality in Solar Filaments Comparison of Unromospheric and Coronal Chirality in Solar Filaments M.Hagino, Y.-J.Moon, and Y.D.Park(Korea Astronomy and Space Science Institute) (hagino@kasi.re.kr.)

In this study, we have examined the relationship between the chromospheric and coronal chirality using Big Bear Solar Observatory H α and TRACE EUV 171 Å data of 60 solar active regions from June 1998 to October 2004. Martin et al. (1998) reported the hemispheric tendency of chromospheric chirality of filaments, known as "dextral" and "sinistral". On the other hand, using the bright and dark threads character in filaments, Chae (2000) introduced a method of determining coronal filament chirality sign.

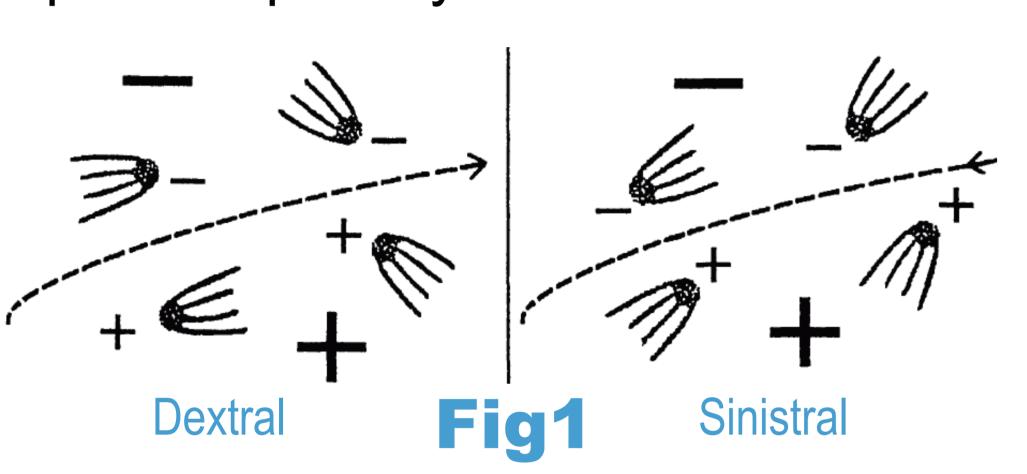
Chromospheric Chirality

(Martin et al. 1998 Solar phys, 182, 107)

If the filament channel goes to right from the positive polarity.

Sinistral

If the filament cannel goes to left from the positive polarity.



Coronal Chirality

(Chae. 2000 ApJ, 540, L115)

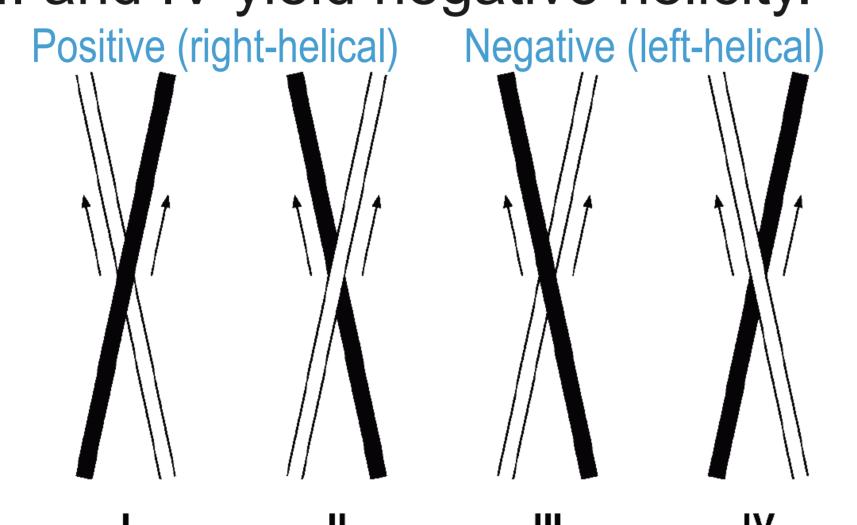
Positive (right-helical)

The crossings of bright and dark threads

I and II yield positive helicity.

Negative (left-helical)

The crossings of bright and dark threads III and IV yield negative helicity.



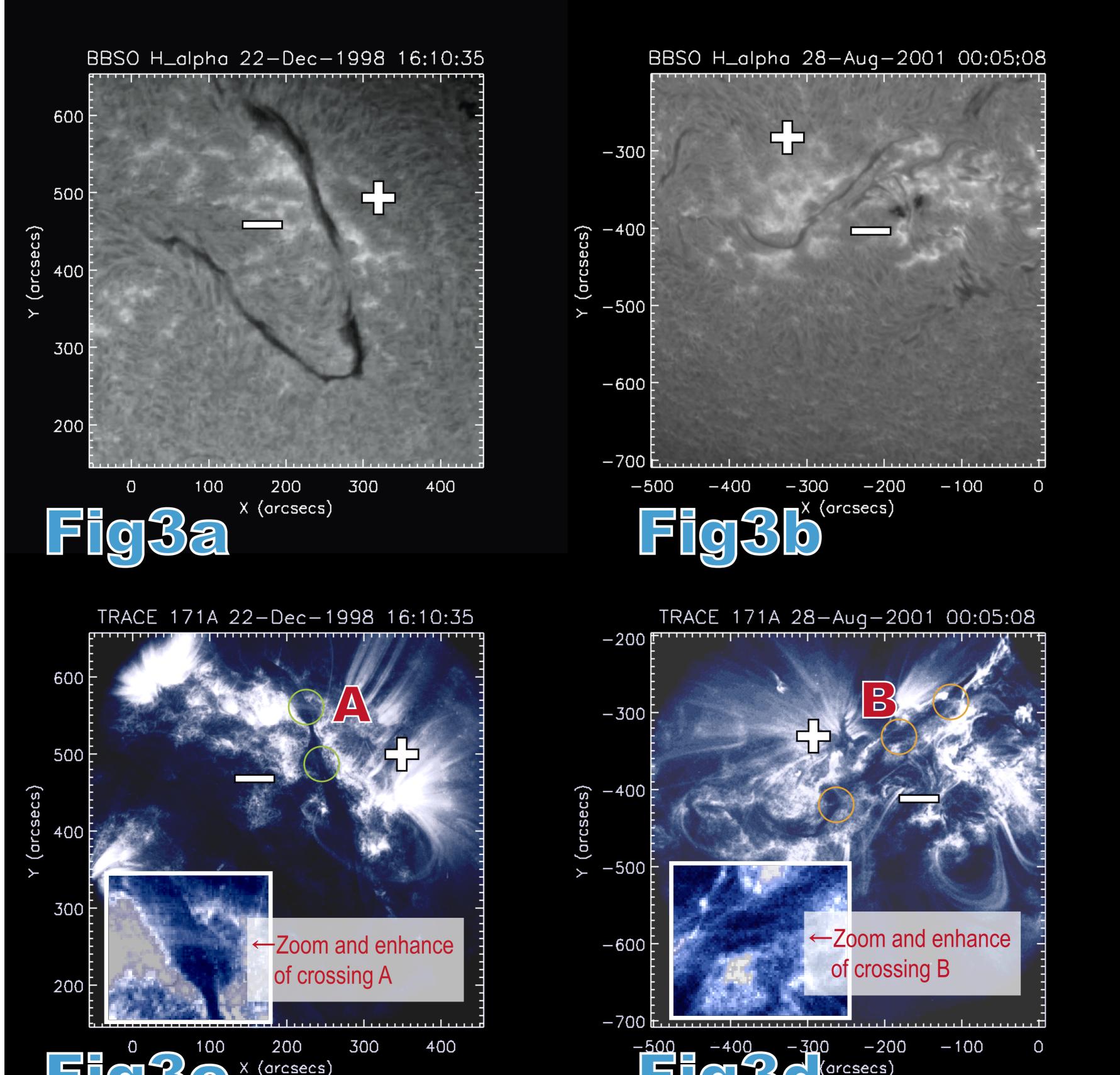
Data

The data used for this study consist of full-disk H α images (0.6 arcsec/pixel) observed at Big Bear Solar Observatory from June 1998 to October 2004. We used high-resolution EUV images taken by TRACE (Trangent Region And Coronal Explorer) at the wavelength of 171 Å. We selected 60 active region filaments located within longitude ±30° to avoid the projection effect. Since almost filaments (about 80%) show purely dextral or sinistral according to Pevtsov et al. (2003 ApJ, 595, 500), we determined the chiral sign of the active region by one to one correspondence.

The filament in Figure 3a was observed on 1998 December 22 in NOAA 8414. In north and south end of the filament, we can find channels. Since south end of this filament is rooted in positive-flux region, whereas the northern end is rooted in the negative flux side. These channels go to right ward form an observer looking at the positive polarity side. Thus, the filament is dextral.

In the EUV image (Figure 3c), a coronal filament (dark thread) can be seen in absorption over the H α filament. Two green circles denote faint crossing threads. In both crossing, bright threads overly the dark thread correspond to type IV. Type III and IV are negative chirality (Chae's method). Namely, this filament shows that the dextral filament has a crossing negative chirality.

Type IV Negative



The filament in the Figure 3c was observed on 2001 August 28 in NOAA 9591. In center of the filament, we can find channels. Since south end of this filament is rooted in positive-flux region, whereas the northern end is rooted in the negative flux side near the sunspots. These channels go to left observer positive looking at polarity side. Thus, the filament is sinistral.

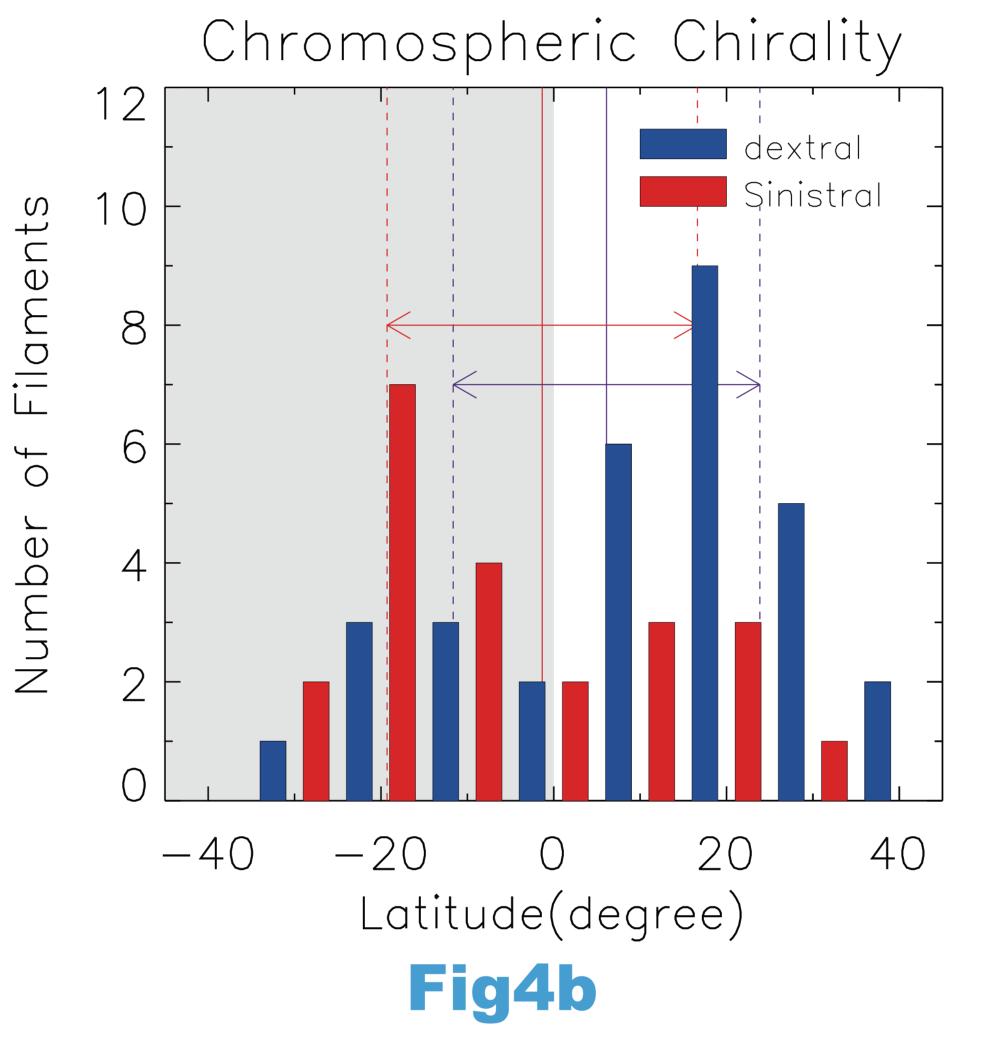
Sinistral

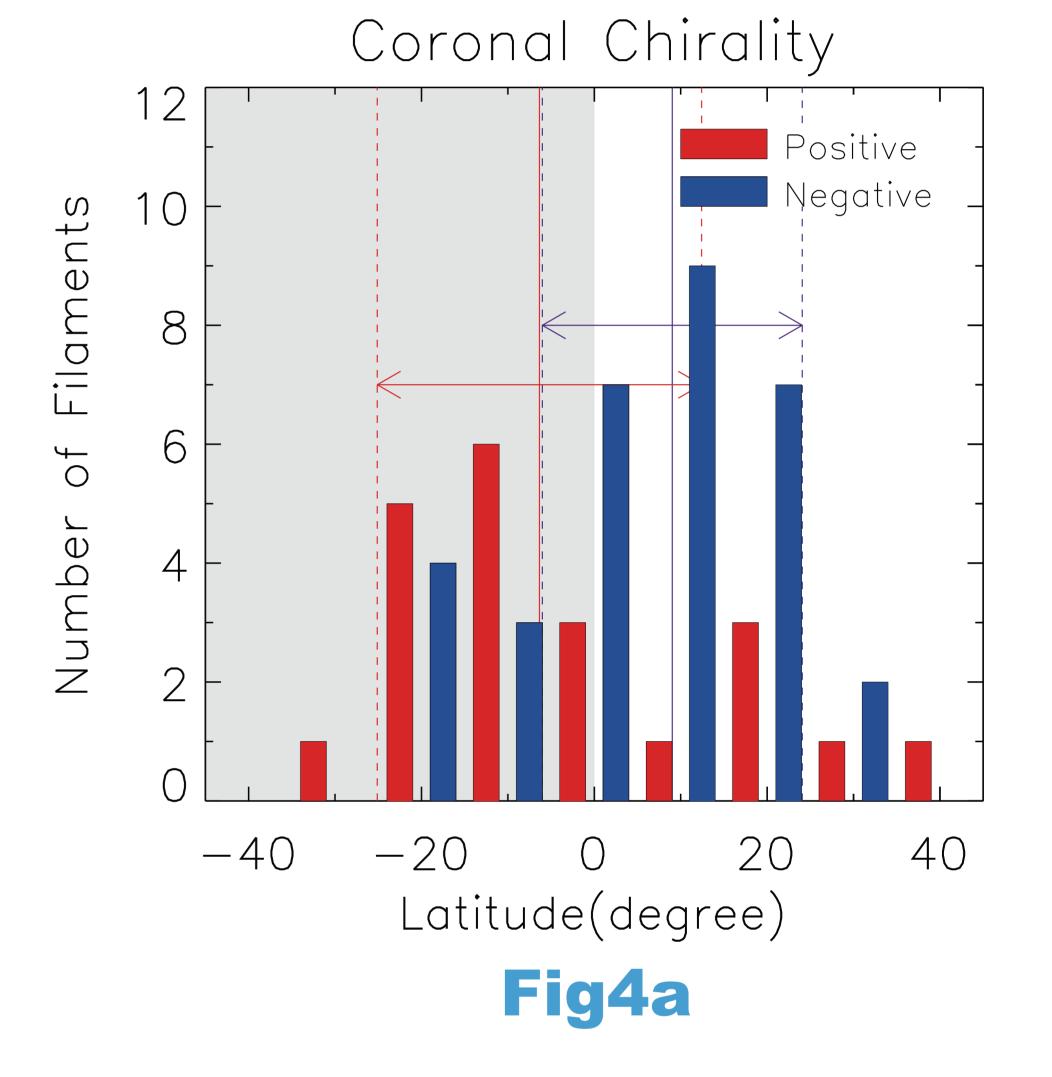
In the EUV image (Figure 3d), a coronal filament (dark thread) can be seen in absorption over the H α filament. Three orange circles denote faint crossing threads. In all crossing, bright threads overly the dark thread correspond to type II. Type I and II are positive chirality (Chae's method). Namely, this filament shows that the sinistral filament has a crossing positive chirality.

Type II **Positive**

Figure 4a shows a latitude distribution of dextral and sinistral filaments. We studied the chirality of 60 active region filaments (35 filaments in north hemisphere, 25 in southern hemisphere). We found that 68.3%(41 out of 60) of chromospheric filaments agree with the hemispheric tendency. Therefore majority chromospheric filaments in northern (southern) hemisphere are dextral (sinistral). And 31.6%(19 out of 60) of the filaments disagree with the hemispheric tendency. The mean latitude of dextral filaments is 6.1 ± 17.8 , and of sinistral is -1.3 ± 18.0 . The mean latitude shows solid line and 1σ shows dashed line and arrows in the Figure 4a.

Figure 4b shows a latitude distribution of positive and negative chirality in coronal filaments. These active region filaments were selected from same active region of chromospheric data. 26.6%(16 out of 60) filaments in northern (southern) hemisphere show positive (negative) and 73.3%(44 out of 60) in northern (southern) hemisphere show negative (positive) chirality. The mean latitude of positive chirality filaments is -6.3 ± 18.8 , and that of sinistral is 9.2 ± 15.0 .



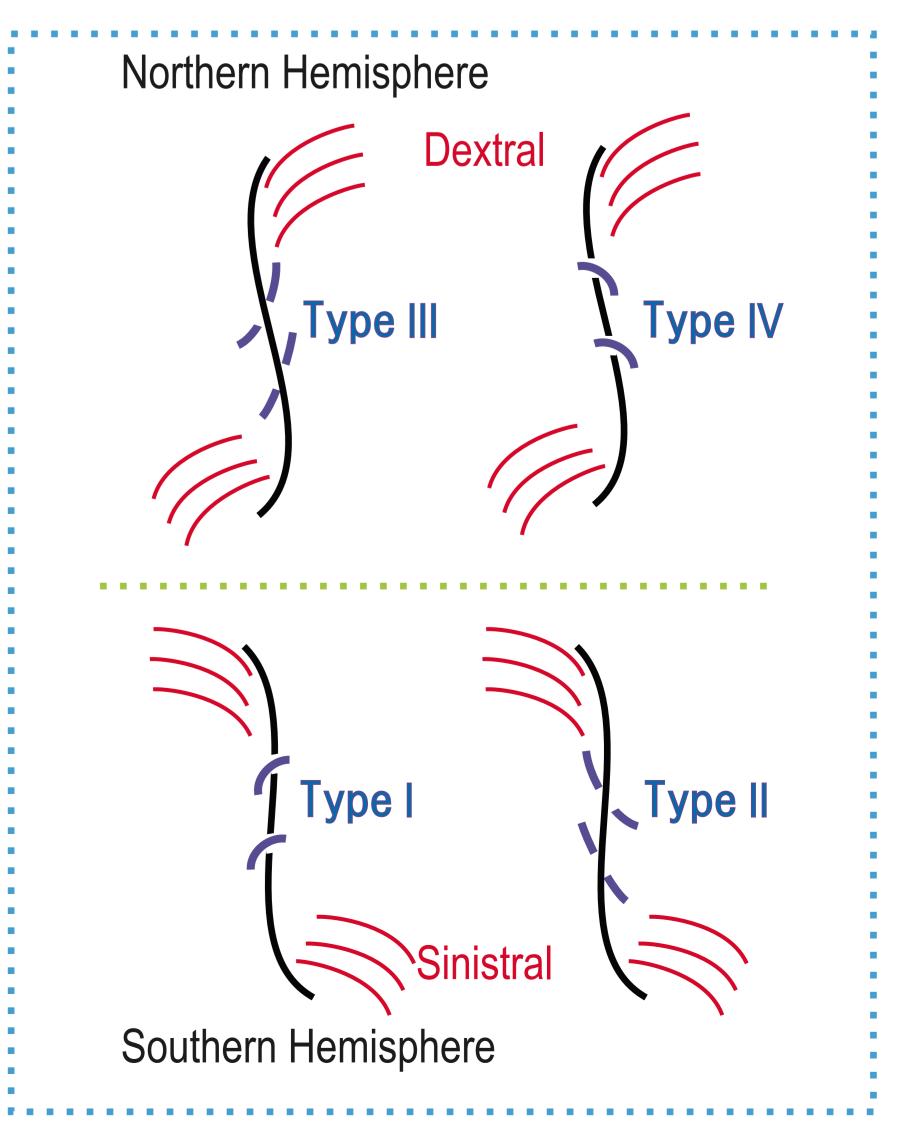


We examined the comparison between chromospheric and coronal chirality. 38.3% (23 region) of filaments show that dextral (sinistral) chromospheric chirality indicate positive (negative) coronal chirality. 61.6%(37) regions) of dextral (sinistral) filaments indicate negative (positive) coronal chirality. Table 1 indicates number of filaments in chromospheric and coronal chirality sign.

Table1 Coronal chirality positive negative Chromodextral spheric sinistral Chirality

Discussion

In this study, we examined chromospheric and coronal chiralities used by the H α and EUV 171 Å images. This comparison clearly : shows that dextral filaments are dominant in the northern hemisphere, sinistral filaments in the southern hemisphere. In the corona, these filaments show negative helicity in the northern hemisphere, and positive chirality in the southern hemisphere, respectively. Since chirality and helicity denote same sign of the twist direction, our results are consistent with the hemispheric : tendency of magnetic helicity obtained from photospheric magnetograms. Comparing between chromospheric and coronal chirality, about 60% of filaments in each hemisphere exhibit that dextral (sinistral) filaments show negative (positive) chirality. The relationship between chromospheric and coronal chirality was i illustrated in the Figure 5.



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